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18 Mar 2010

WorldView-2 (WV-2) Characterization and ICC Profiles

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Engineered for life

Overview

- The Need for Characterization
- The Process
- Insertion into the Processing Architecture
- Transformation to Color Management
- Definition of ICC Profiles
- Processing with ICC Profiles

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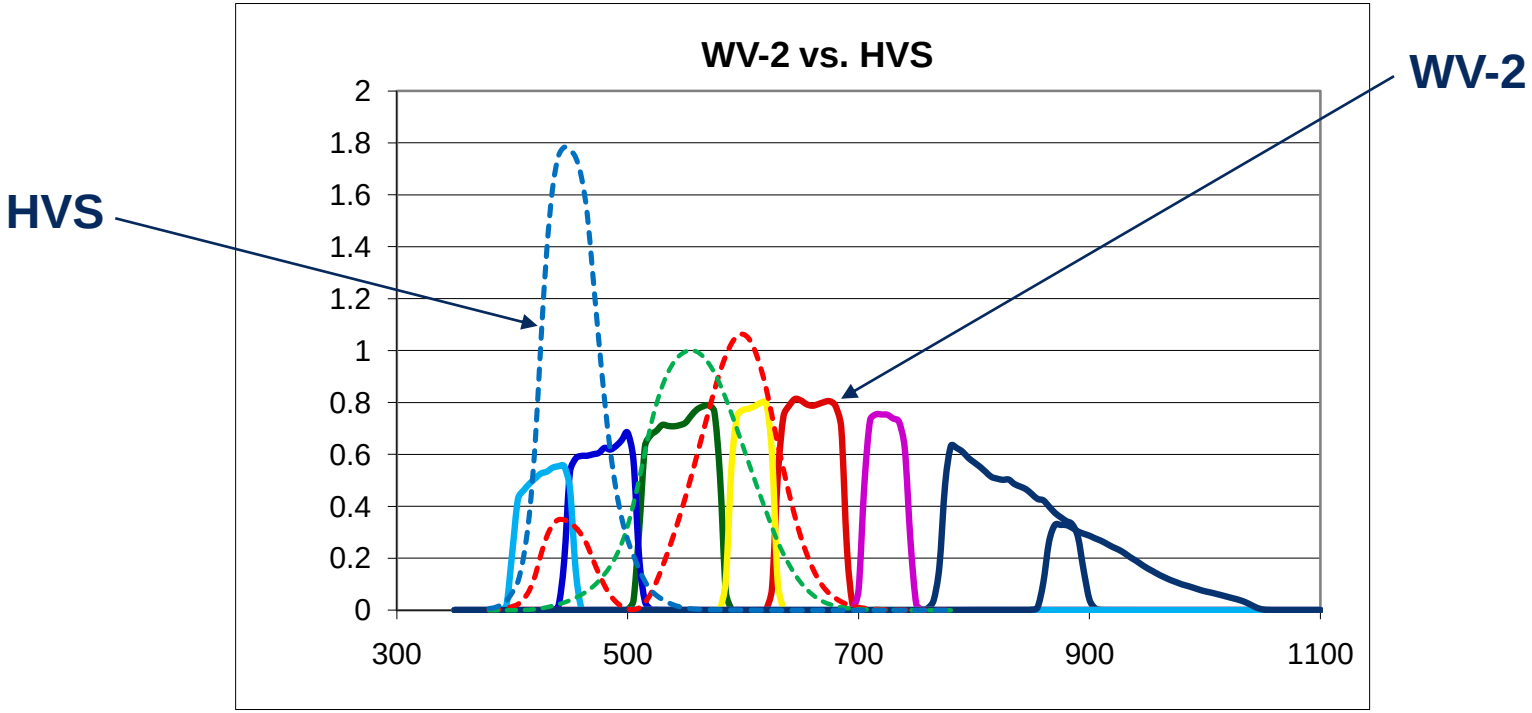
The Need for Characterization

- Spectral Response
  - Capture device does not “see” what the human sees.
  - Need to transform the image from the space the device “saw” to the space that the human observer “sees”



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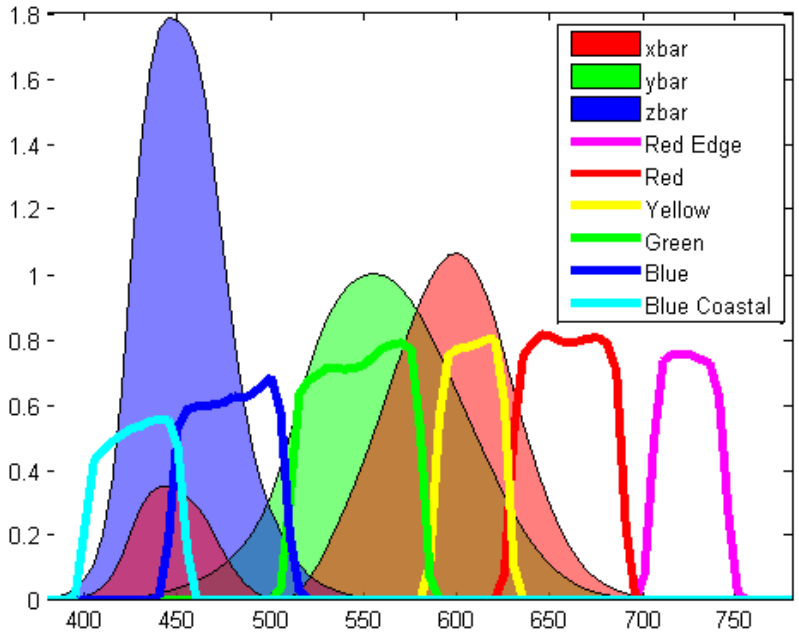
WV-2 Sensor Characterization

- WorldView-2 Spectral Sensitivity allows for much better match to human visual system than previous sensors

Color Matching Functions vs. WorldView-2 Visible Spectral Sensitivities



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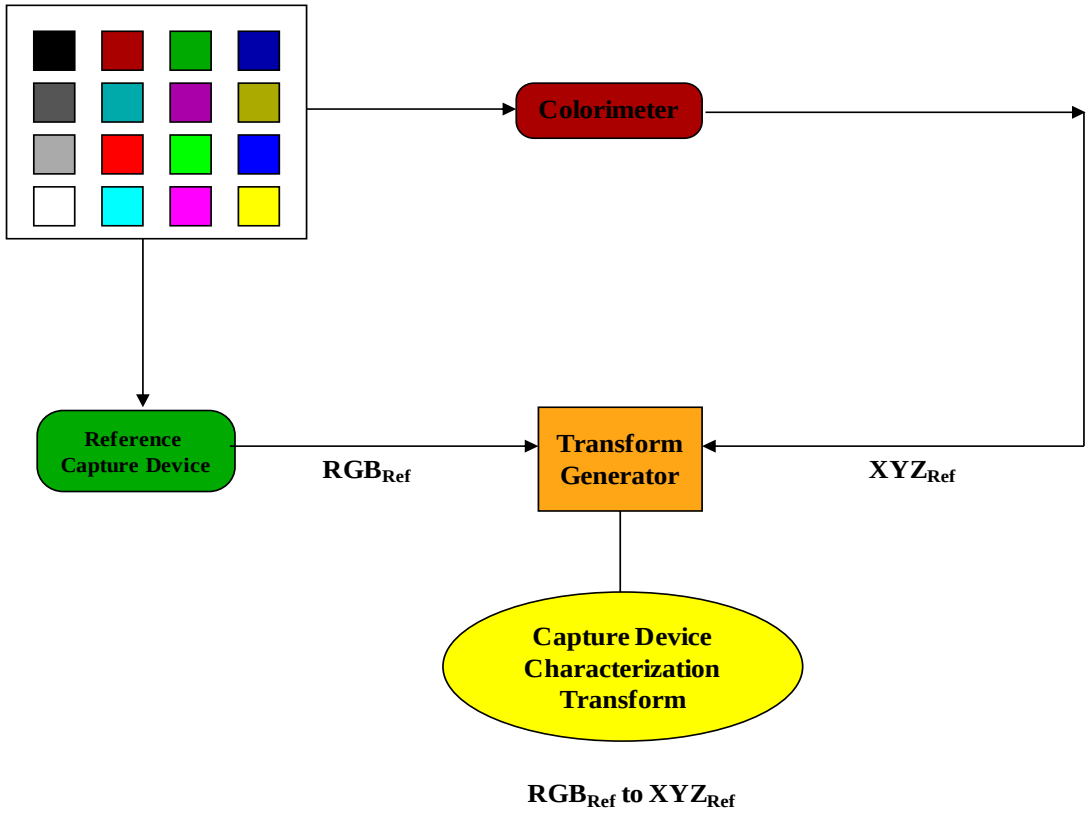
Ground Target Creation

- Determine set of patches needed for sampling color space for given sensor
- Determine number of patches that will appropriate sample the color space
- Build the targets with the corresponding spectra



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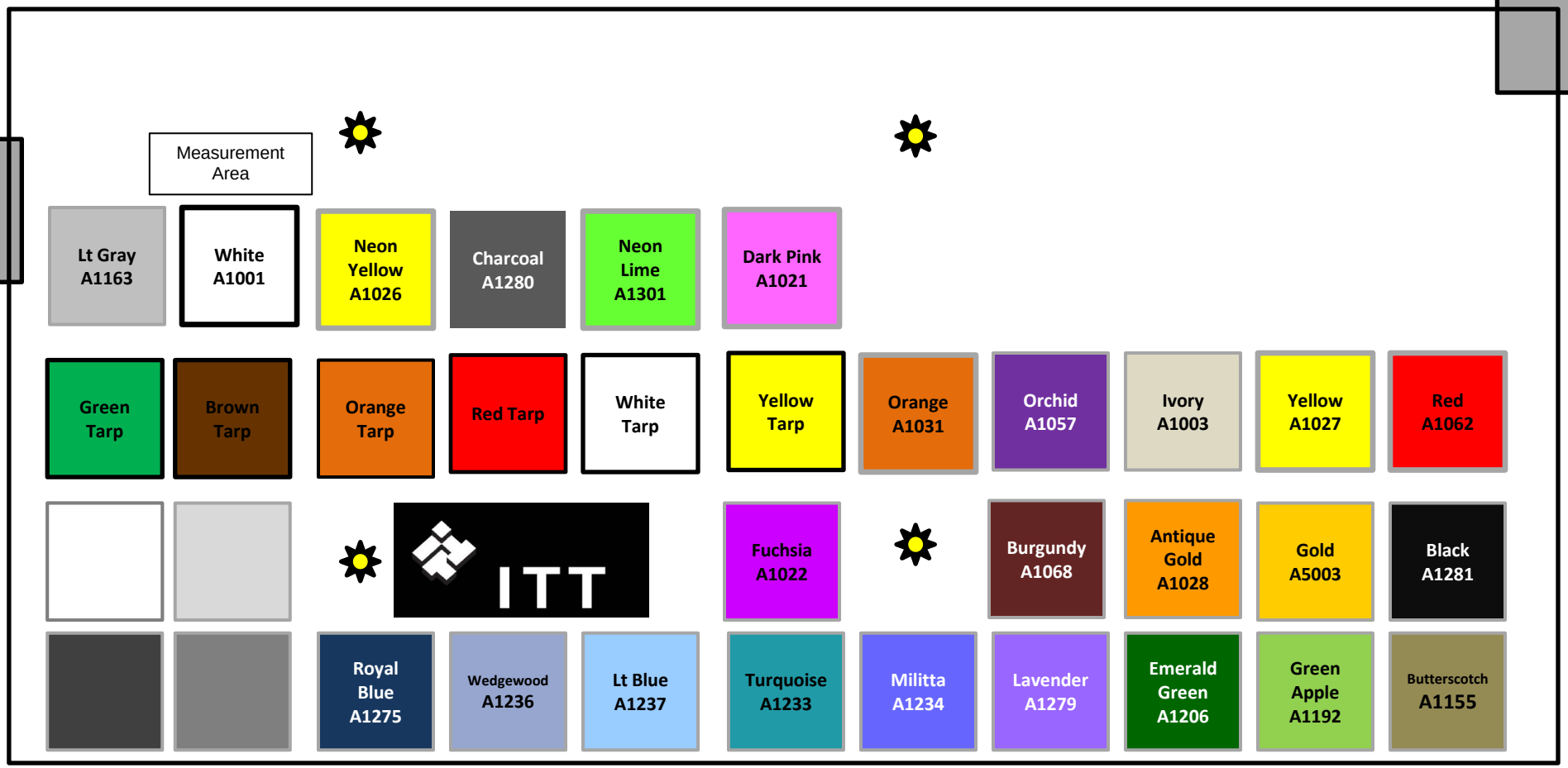
Target Layout



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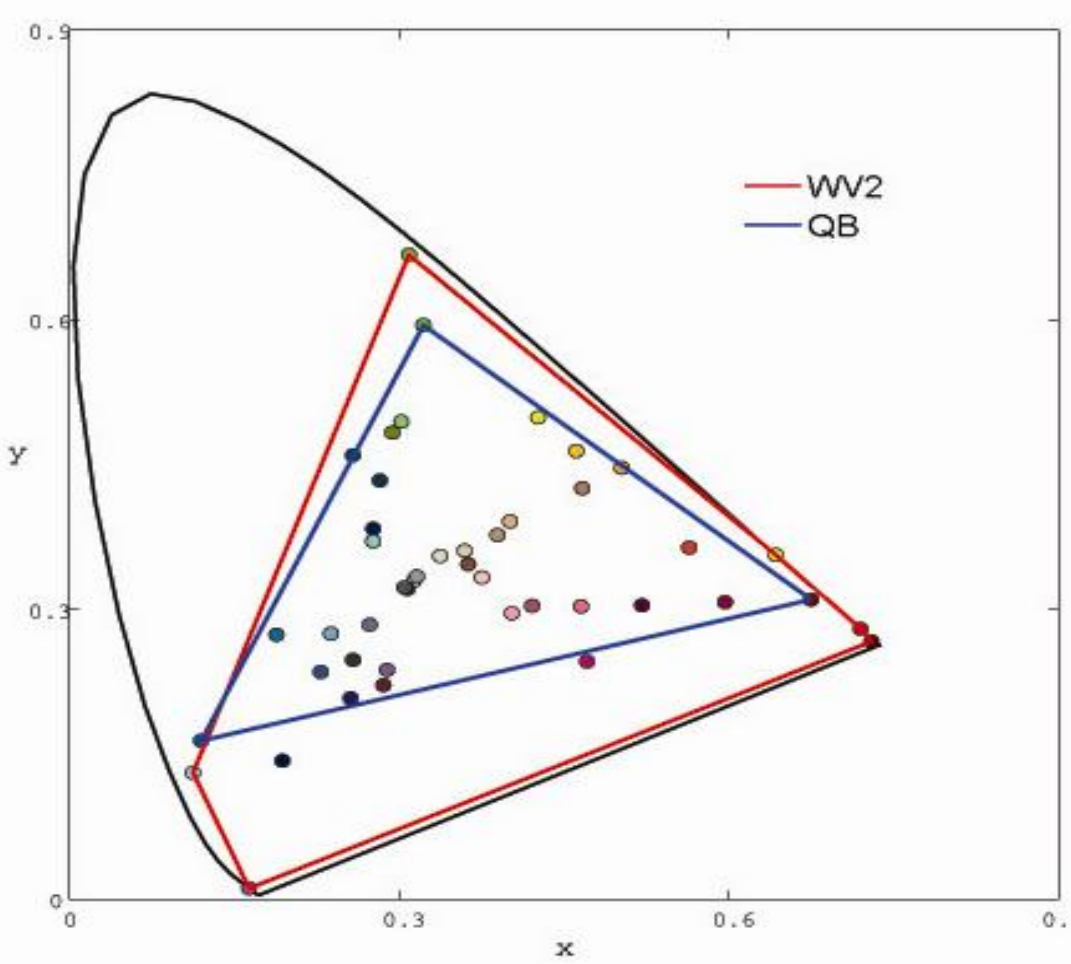
WorldView-2 and QB Gamuts vs. Ground Truth Patches

- Adequate sampling of sensor gamut was accomplished
- Patch colors fit within the gamuts of WorldView-2 and QB sensor gamuts
- Provides ability to characterize either sensor with same targets



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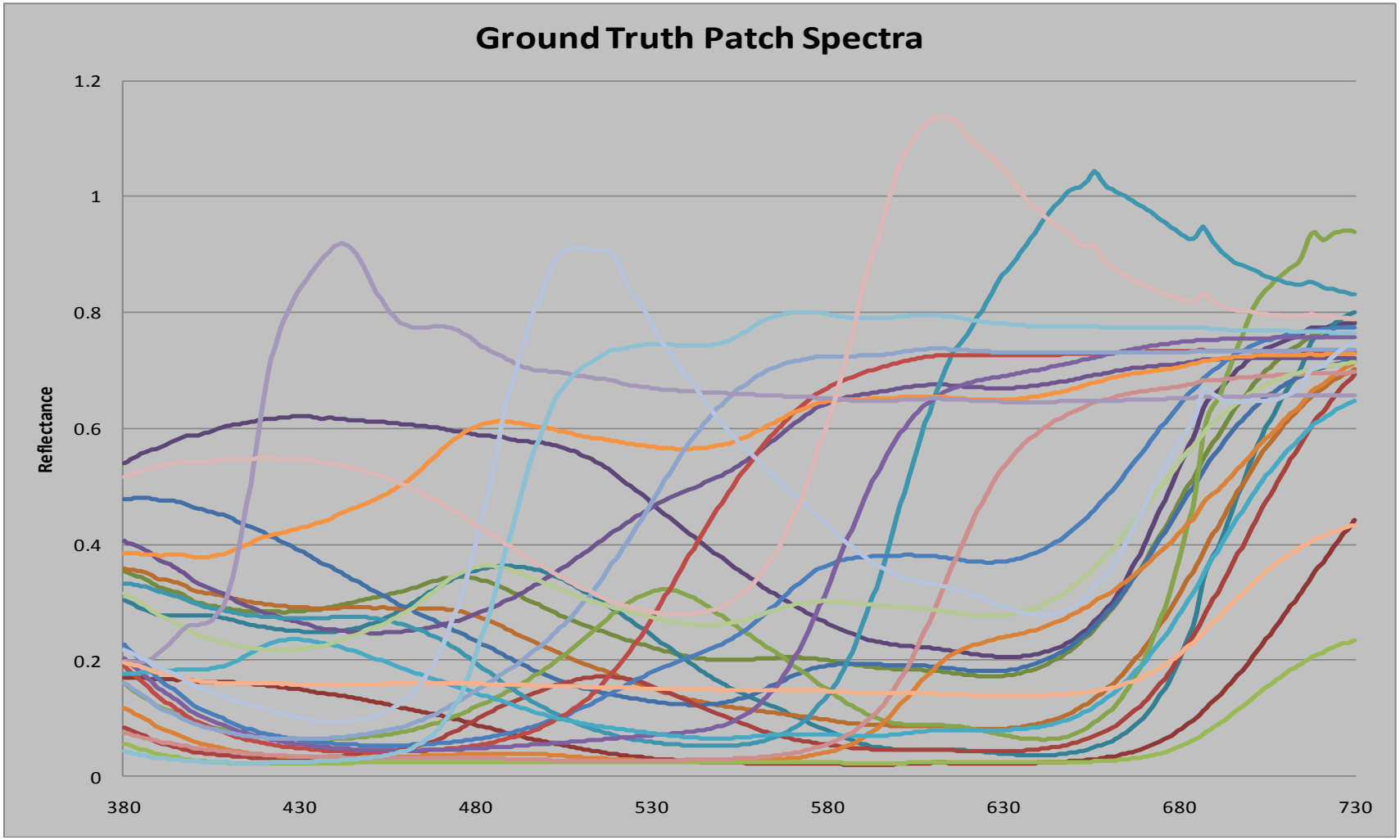
Ground Truth Patch Spectra



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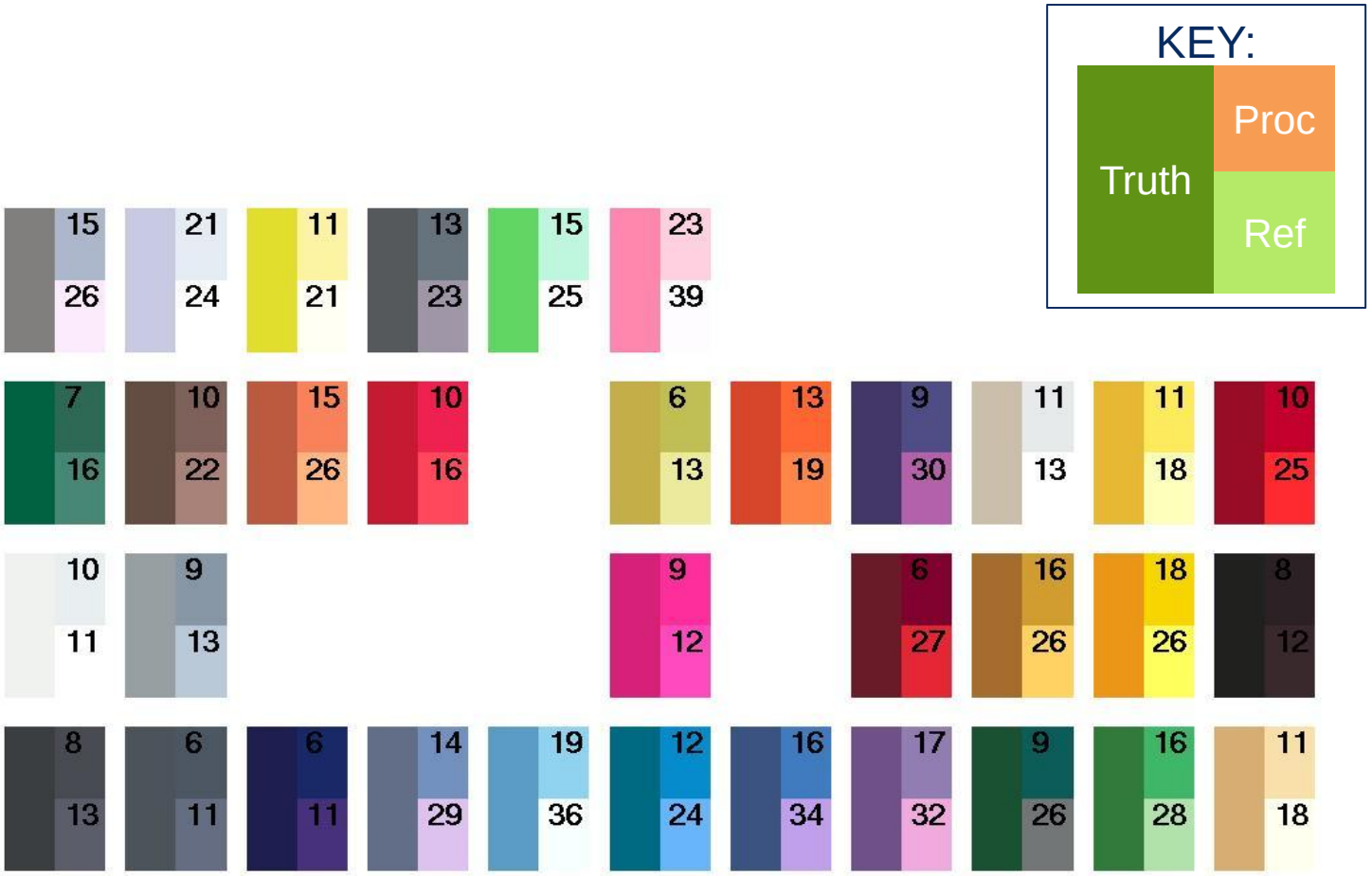
Color Difference Evaluation



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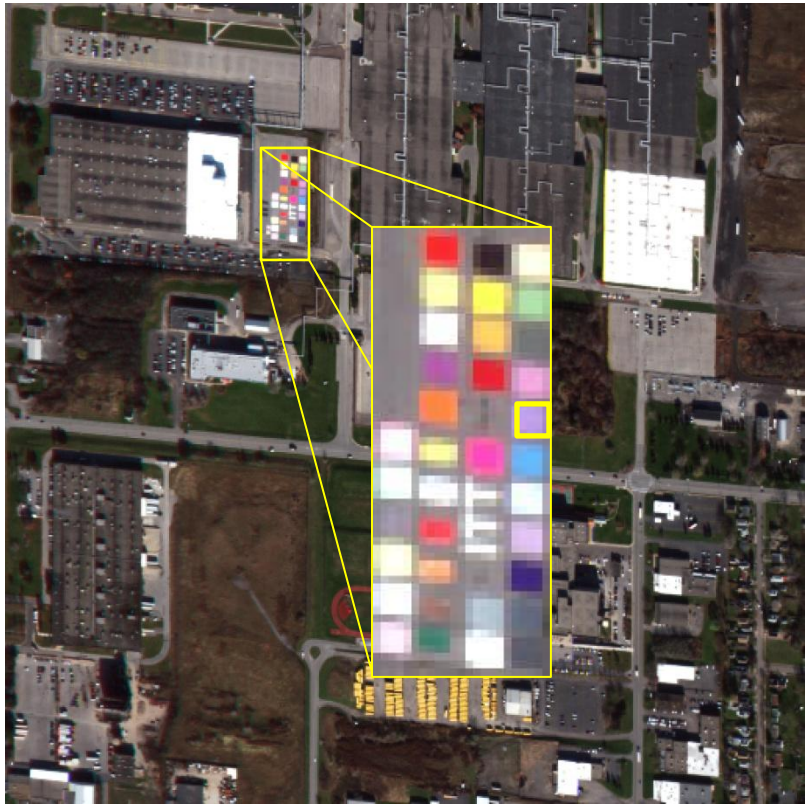
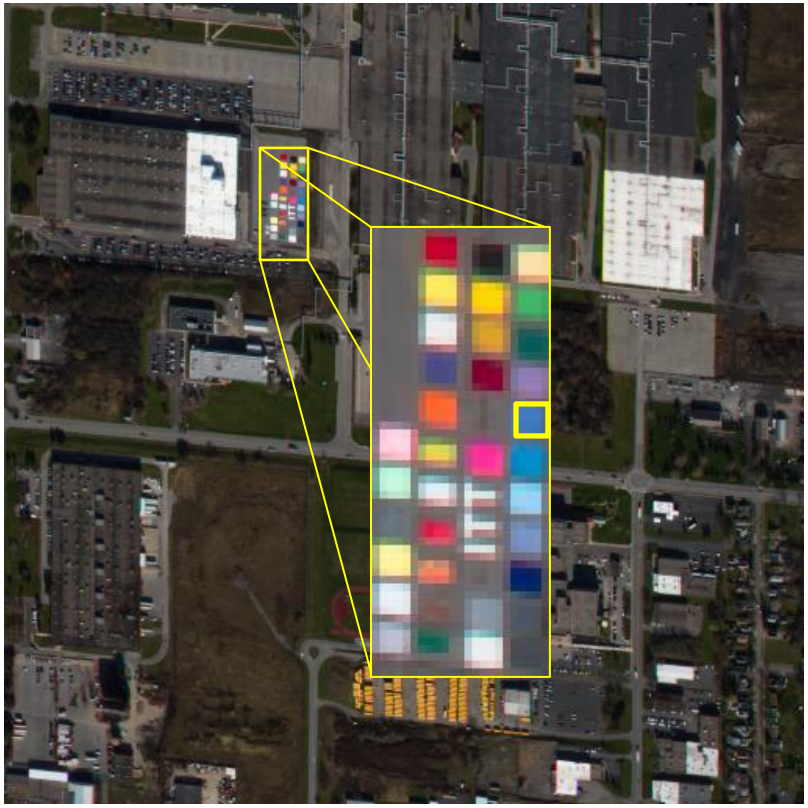
Visual Effect of Characterization

Baseline Processing



Processing Post- WV2 Sensor Characterization



Reference

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Processed

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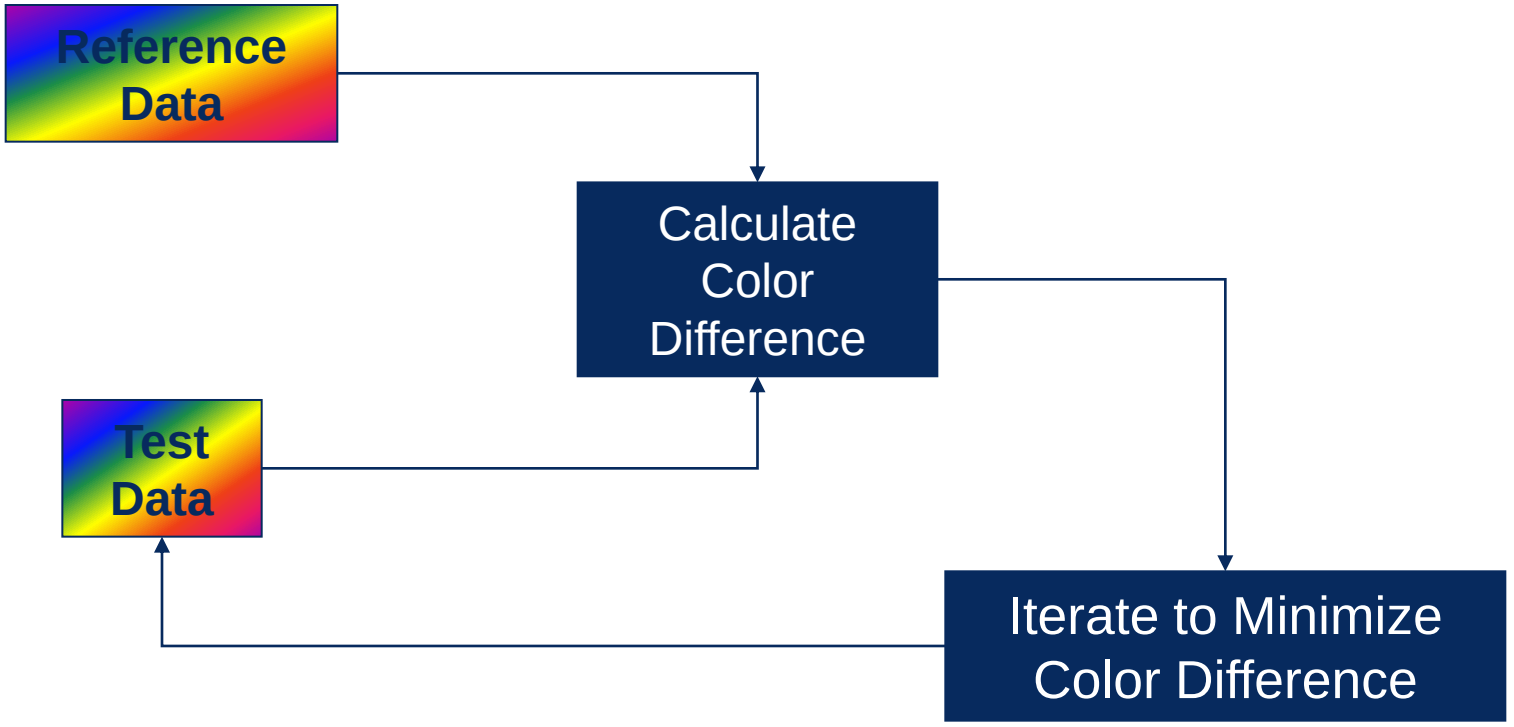
Overview of Color Transformation



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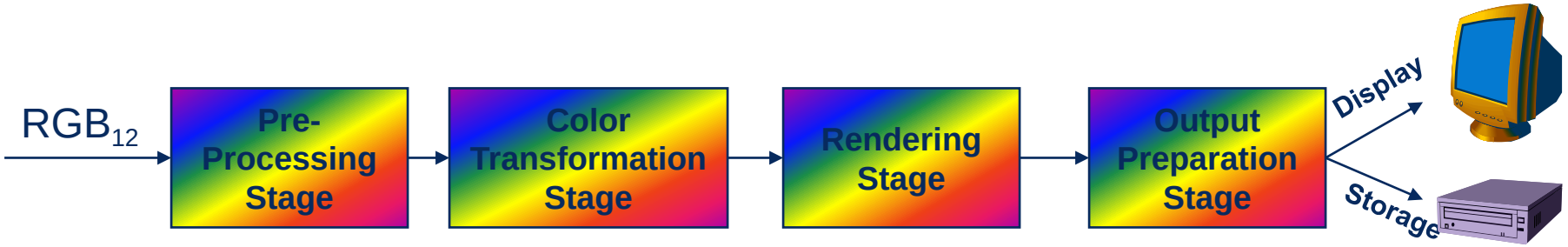
Insertion into the Processing Architecture

- Easily standardized
- Commercially accepted
  - Low risk in adoption
- Adaptable for variety of sensor types through a data driven paradigm



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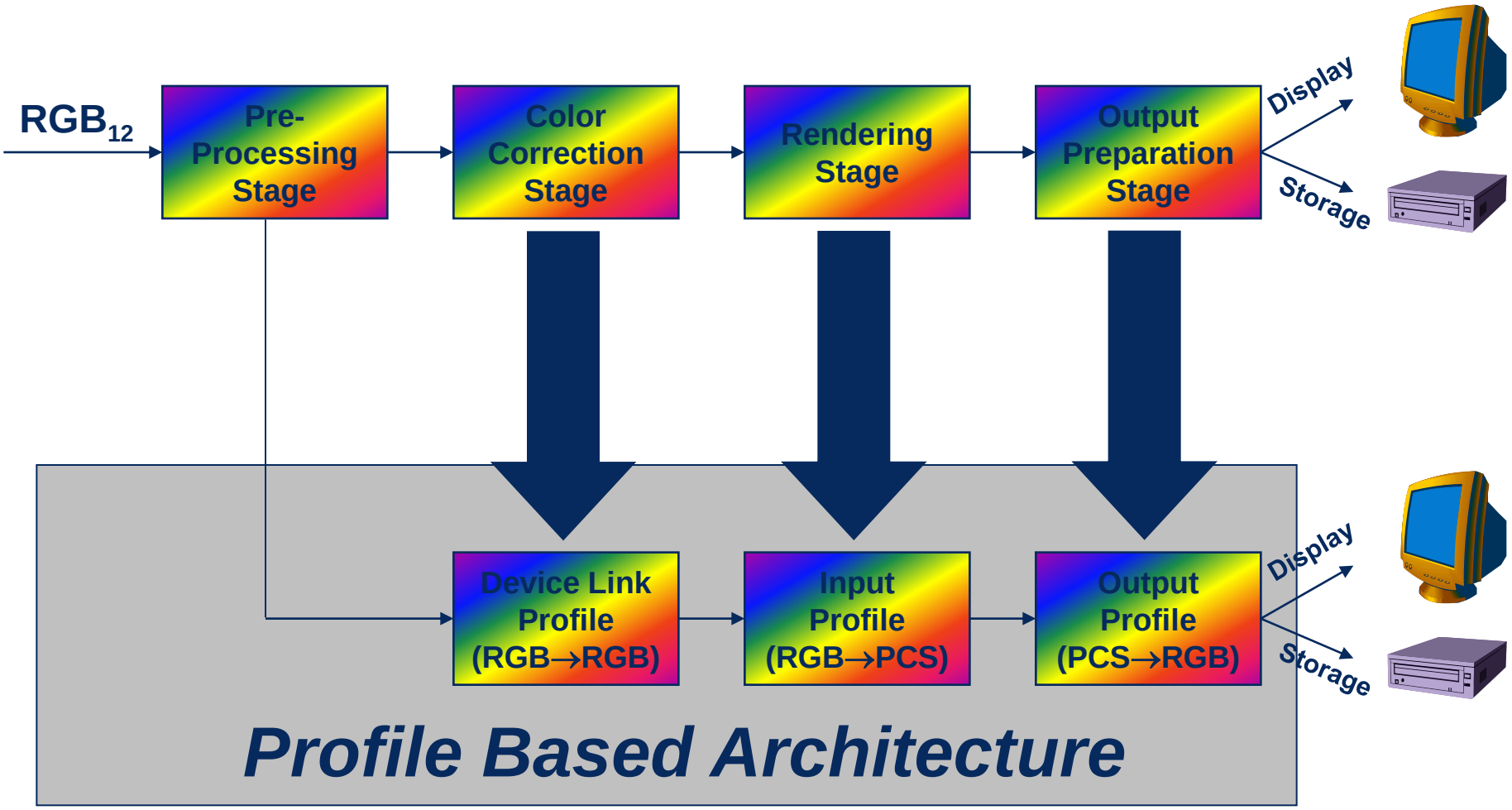
Transition to Color Management



PCS≡ Profile Connection Space

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The Color Management Process (CMP)

- The CMP is a system of well defined steps that ensure that the communication of color is accomplished
- These steps are comprised of binary files called ICC profiles
  - ICC ≡ International Color Consortium
  - Profiles convert colors from one device to another
  - There are five (5) types of profiles that can be used in implementation of the CMP
    - Input (RGB → PCS)
    - Output (PCS → RGB)
    - Display (PCS → RGB, RGB → PCS)
    - Device (RGB → RGB)
    - Abstract (PCS → PCS)

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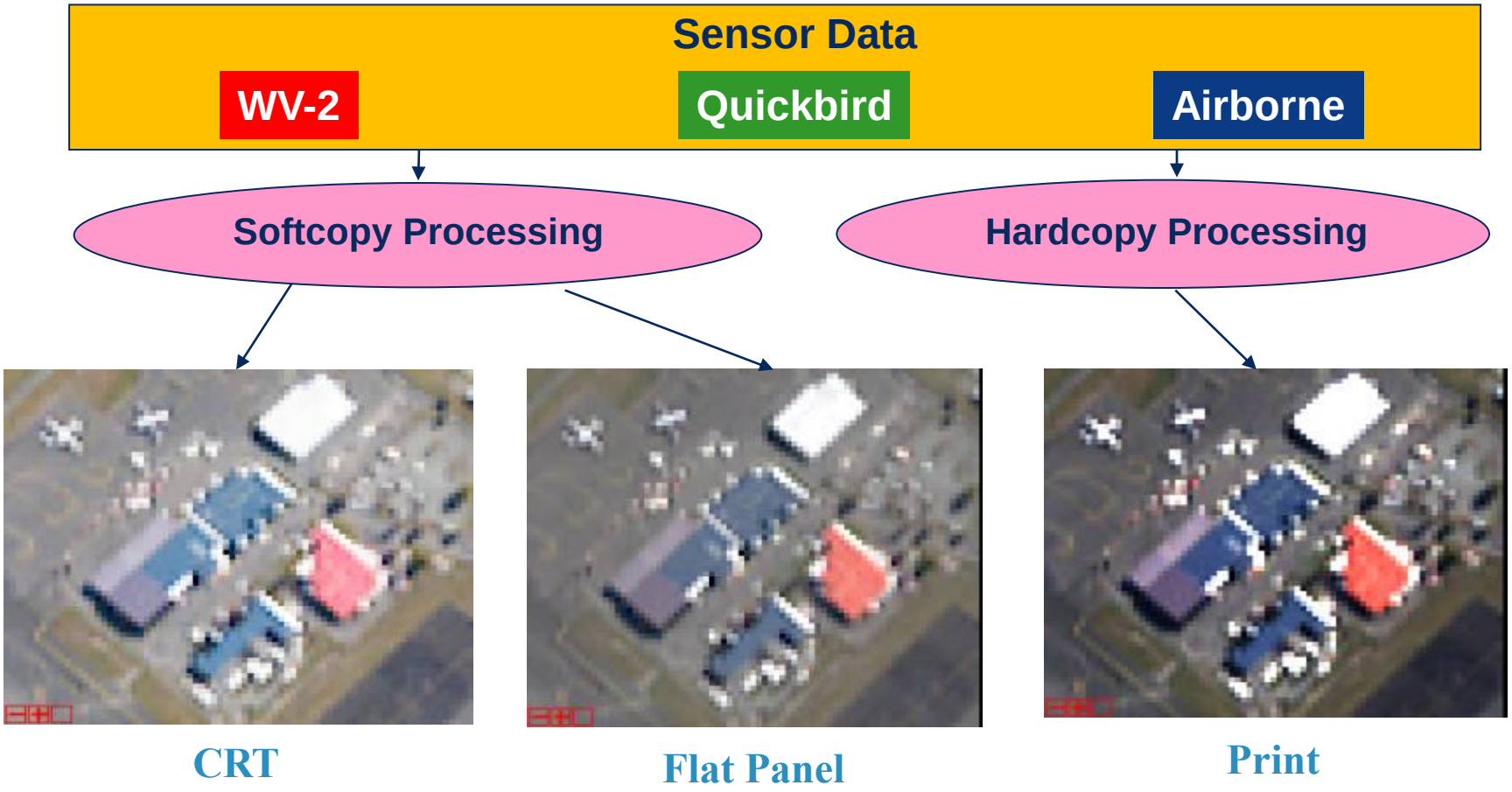
Current Color Communication Issues

- Each device speaks it's own color "language"



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The Color Management Process (CMP)

- The language concept is used to “communicate” color
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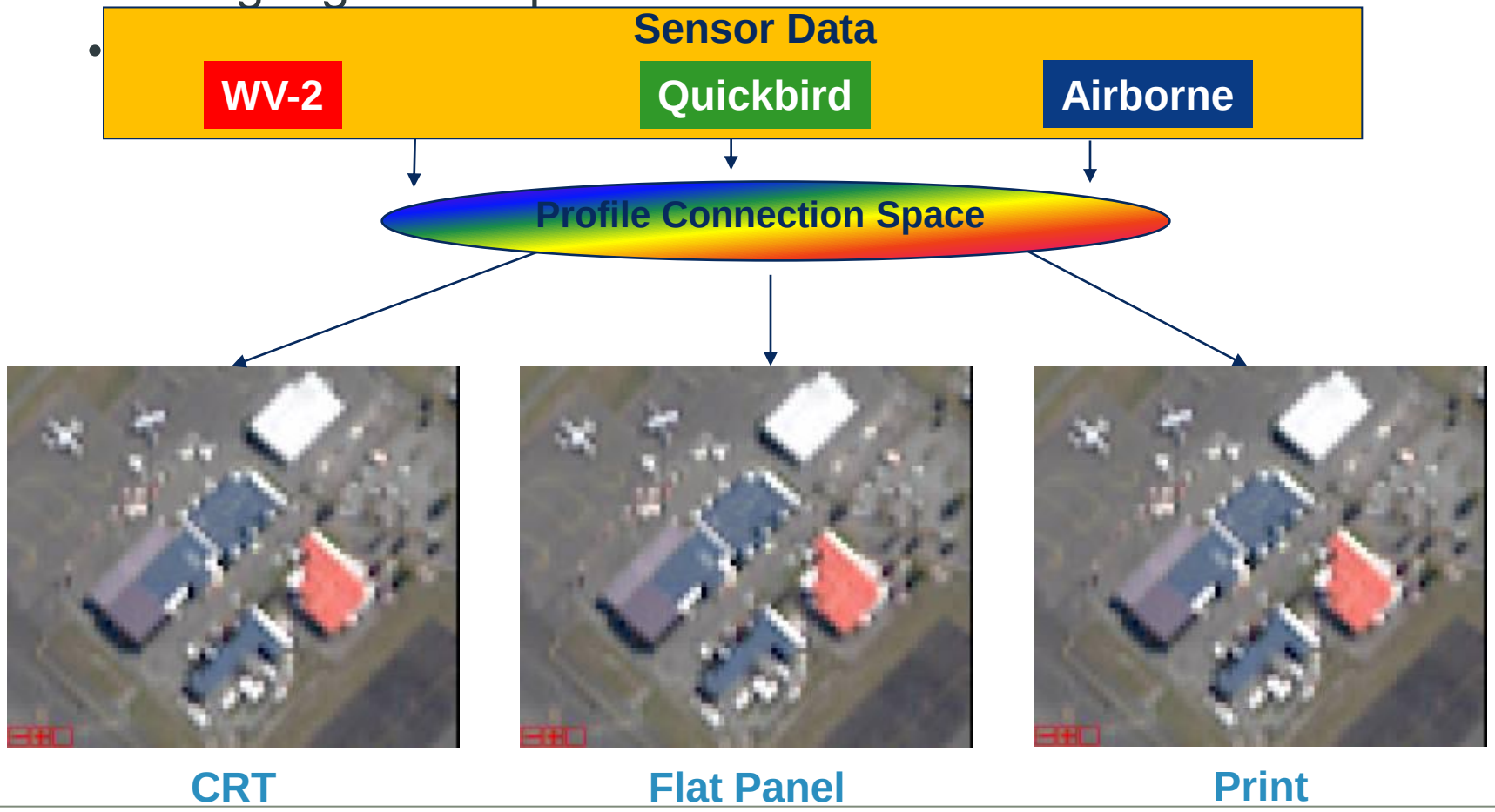

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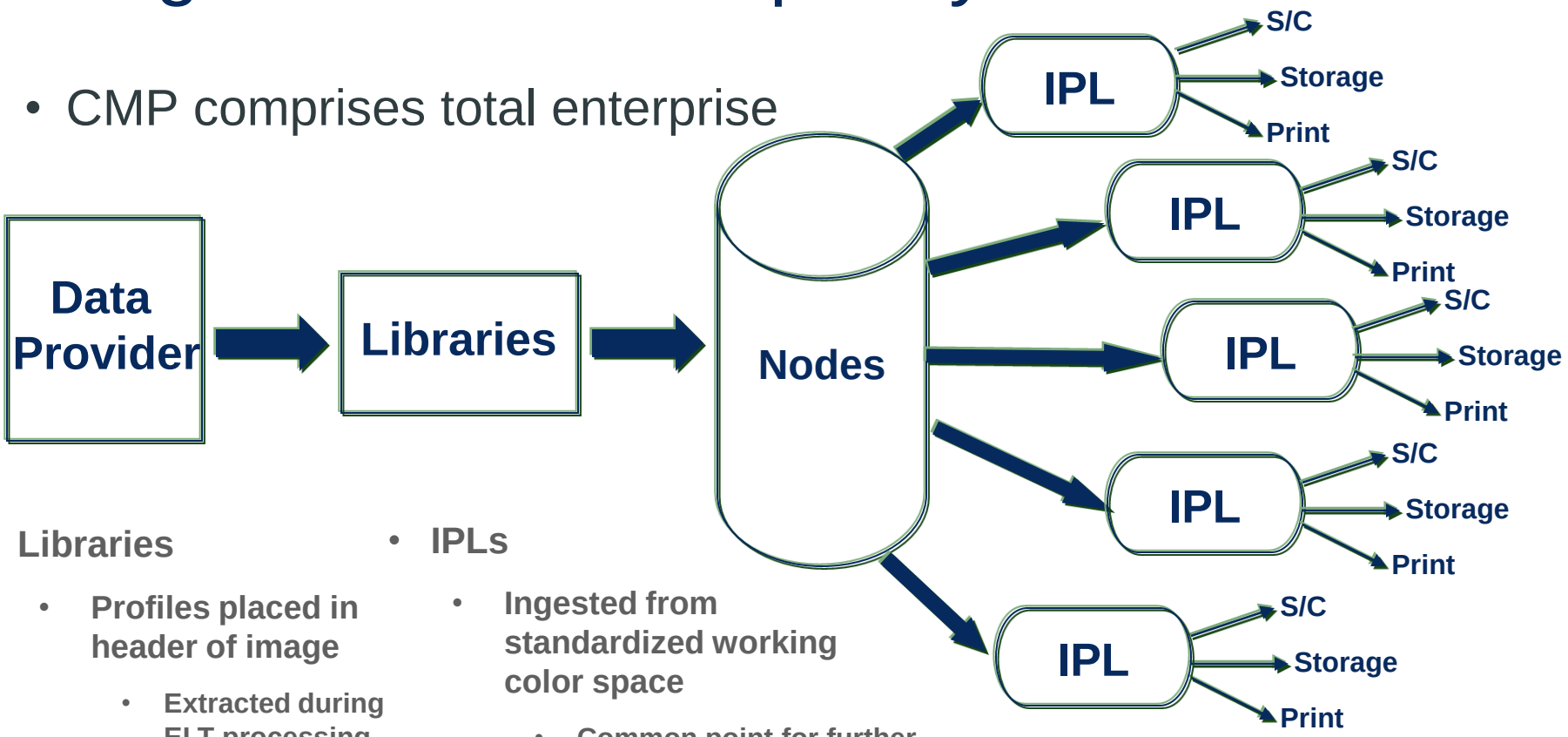
Integration into Example System

- CMP comprises total enterprise



- **Libraries**
  - **Profiles placed in header of image**
    - **Extracted during ELT processing**
  - **Enables ease of use**
- **IPLs**
  - **Ingested from standardized working color space**
    - **Common point for further S/W processing or output to H/C**
  - **Can store color/tonal moves for later usage**

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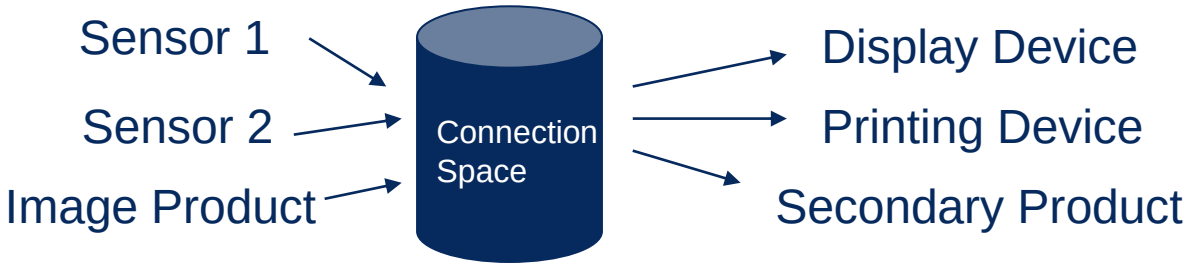
ICC Profiles

- The International Color Consortium defined a standard for defining image processing color and tone transforms
- Uses “connection space” to do processing.
  - Sensor RGB is converted to connection space
  - Image is converted from connection space to display digital counts on target device
  - Commonly used connection space is CIEL*a*b* or tristimulus XYZ
  - Connection space is a defined reference that allows for hand off from one device to another without knowledge of detailed device characteristics
- Use of common space allows interchange between various inputs (e.g. sensors, libraries) and outputs (e.g. displays, printers)



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ICC Profile Types

- Device (native device → independent device [Profile Connection Space–PCS])
- Input (sensors, scanners, cameras)
  - Display (monitors)
  - Output (printers, plotters)
- DeviceLink (device → device)
- ColorSpace conversion (non-device → PCS)
- Abstract (PCS → PCS)
- Named Color (device → PCS; for specific colors, not images)

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Summary

- Characterization of a sensor is needed to ensure that proper visual presentation is obtained
- Characterization also enables multiband systems to effectively utilize their native bands for more optimized processing
- A color managed paradigm is necessary for multiband systems to obtain the best flexibility and utility of their sensor bands
- The color management process is a means to achieve standardized processing as well as flexibility when working with multiband imagery
- ITT has developed capabilities that will allow for the application of color managed techniques multiband imagery

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